"JOURNAL OF THE CONSTRUCTORS CLUB"

Hot Iron

Spring 2013
Issue 79

Contents

The Walford Electronics website is also at www.walfordelectronics.co.uk

Editorial

The sun is out once more! Hurrah and the water is receding too - we will soon have a draught! My notes in the last Hot Iron about DDS and micro-processors did produce some welcome comments. One member, who is a keen builder, said they were jolly good things and were right for modern home built radios! A more widely held view was that they were excellent devices when kept apart and should not be combined in home built radio gear! Often the overhead of running any form of digital processor outweighed the simplistic approach that the rest of the radio might employ! Thank you to all contributors anyway - comments on any topic are always very welcome!

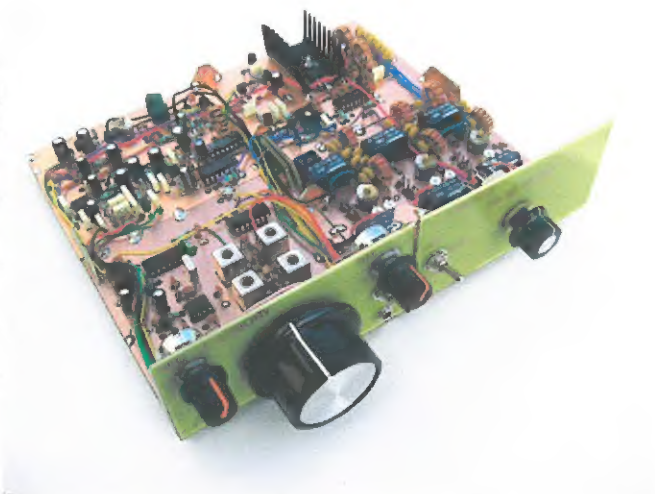
One member has recently suggested that I ought to address the new low frequency bands - 472-479 KHz and lower. I would be interested to hear of anybody else who would be interested. The circuits ought to work easily at these low frequencies, perhaps with larger coupling capacitors etc, but where an inductor is required that might be a bit more challenging - too many turns to fit sensibly on a powdered iron toroid so ready made inductors would be needed! Also the maximum value of trimmers is hardly enough for easy adjustment of resonant frequency. Measurement of frequency will be more important to make sure you remain in band! I must look in my store of old adjustable TOKOs!

Tim G3PCJ.

Kit Developments

The **Cadbury Castle** (right) and all its component kits are now in 'production' form after a small mod to the TX that required PCB alterations. I shall be writing this up for PW shortly and would be delighted to have any early builders who might be wanting a full break in 5W CW four band DC TCVR - all bands 20 - 80m!. I have laid out (but not yet tried) the phasing optional extra kit. Ask me for details.

I have also etched the prototype **Lydford** SSB 5W TCVR - single PCB - any single band 20 - 80m. This is a modern Tiny Tim for those with long memories! I also now have a Minster TX PCB too!! Tim



Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £8 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics– is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ © G3PCJ

Measuring inductance - by Peter Thornton

I recently bought an L-C-R "digital meter", from a well known on-line auction sales outfit. I checked the ranges using components I had to hand; the instrument readings came very close to expected, and I was impressed by the instrument.

A project I have on my bench at the moment calls for a 60W linear amplifier, and before running a linear, I always connect a 50 ohm dummy load to the output. I recently built a new dummy load, and checked it's resistance with my L-C-R meter: 50.02R.

Because I could, I checked the new dummy load's inductance - it should be purely resistive. It read 280 micro-henries! What? Metal oxide resistors are non-inductive, where had 280uH come from?

A idea presented itself. The L-C-R meter doesn't measure inductance directly, it infers it from pulses through the coil - and a coil is almost a "dc" short circuit. A dummy load has *resistance*. The meter interpreted 50R as 280uH! A simple test proved the point: a tiny 1/8W 47R resistor, when measured, gave similar big "inductance" readings - but the resistors were so small the inductance could only be a few nH.

Suspicions proved: the inductance measurement is thrown by resistance. Job done, linear runs fine!

Sorting out unknown ferrite cores

Peter Thornton has written a note on his experiences trying to do this but it was too long to include here, so I will attempt to summarise it. If you are seriously interested I can put you in touch. (G3PCJ)

Ferrites come in four main categories which are the intended frequency of use bands - 1, Very Low Freq types for power line filters for under 1 MHz; 2, switch mode PSUs - good for use on 40 –160m; 3, cores intended for HF 'chokes/transformers' good to 30 MHz; and 4, V/UHF types used for convenience in things like aerial splitters. Almost always, the higher the inductance for each turn, the lower the frequency of use. Get an idea of what this critical A_L figure should be by looking up manufacturers data sheets - Fairite etc.

Then put on a few turns and resonate with a capacitor, and measure resonant frequency with a dip meter. This will often need a separate turn or two around the GDO coil connected in series with the unknown L and the known C. Its handy to have a range of small capacitors available - 22 pF to perhaps 470 pF. Experiment with the Cs and GDO ranges until you find a strong dip. Then work out the inductance from the standard formula for resonance. Peter reckons you can obtain an impression of the inductors Q by judging how wide the resonance dip is but my experience is not good at that! Most often we want devices that are suited to HF applications, so if the resonant frequency is either below 1 MHz with 470 pF or above 30 MHz with 22 pF, then its unsuitable! A bit crude I know! Finally Peter suggests putting some RF power through it into your dummy load. Ideally one would aim for the inductive reactance of a single winding at the operating frequency to be over 4 times the impedance, ie 200R. So wind on whatever number of turns is required to give 200R! Then put on another winding with the same number of turns. Connect one winding to the TX and one to the dummy load. Gingerly send some RF through it (up to say 5W) and see if it gets warm. If not, then its suitable!

This seems all a bit questionable and needs a fair bit of mathematical skill as well as patience! I must admit to never bothering with unknown cores - the potential troubles are worse than the cost of buying a few known devices from the GQRP Club; keep them in suitably labelled boxes! Do not mix up black unmarked ferrite cores with the easily identified coloured powdered iron cores that are so valuable for making RF inductors. Tim G3PCJ

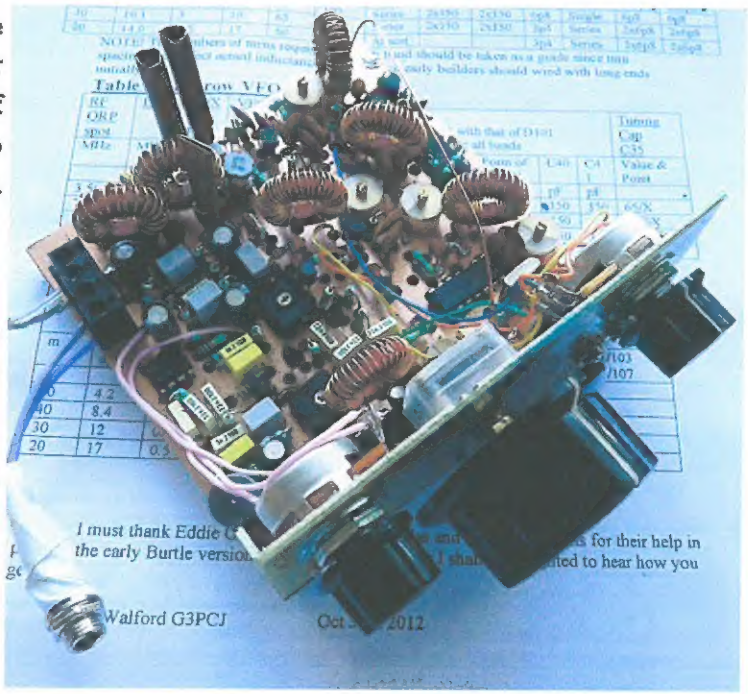
Tweaking up the Berrow - Phillip Thompson G4JVF

I've recently had great fun building one of Tim's new Berrow kits. Just what I wanted in a rig and it worked flawlessly. I initially had it set up on 40 metres but soon wanted to tweak (as you do), and try it on other bands. Doesn't take too long to swap out the coils and capacitors to suit whatever band.

Sadly, I don't have much test gear, a multi-meter and an L/C meter being about it. I also don't own a commercial Ham Radio rig of any sort. In recent times, I've leant heavily on using my Softrock Ensemble 11 SDR receiver as a sort of "Swiss army knife" test rig whilst building various QRP projects.

The beauty of my SDR receiver is that I can align it to known signals such as WWV or whatever, resulting in an accuracy of a few Hz. So, it can tell me exactly what my Berrow VFO frequency is by simply dangling a short wire from the SDR receiver near to the Berrow VFO toroid coil and taking note of where the trace is on the waterfall display of my computer SDR software.

Same idea for sniffing the signal in the mixer, which is VFO and crystal oscillator combined. Whilst watching the trace of the mixed signal, I could peak the two variable caps in this mixing stage with ease.



Last but not least, I can "view" the TX output on my SDR and put my mind at rest that there are no out of band signals to be concerned about.

So far, I've tried this Berrow on 80, 40 and 30m with success and my SDR receiver has made it possible to do the tweaking with ease and accuracy each time...

Next job to try 20 metres..

Softrock Ensemble 11 kit comes from Tony in the USA

http://fivedash.com/index.php?main_page=product_info&cPath=1&products_id=6&zenid=8360bc445bcd2e27da78c0e55de3c88

Phillip sent me an e mail confirming it also worked on 20m the next day! Look at his lovely chimneys on the output stage! Although this rig is marketed as being for any single band 20 - 80m, the method of generating the Local Oscillator signal can be easily adapted for other bands with a different crystal. In principle the set should be viable up to 10m but, because the higher bands will need 16 or 24 MHz crystals, I have not included those bands in the normal offering. With a few minor modifications it could also do 160m. The TX output low pass filters also need different values instead of the normal single set of parts that does any band 20 - 80m! If anybody wants to do a special, let me know and I can easily manage it. Tim

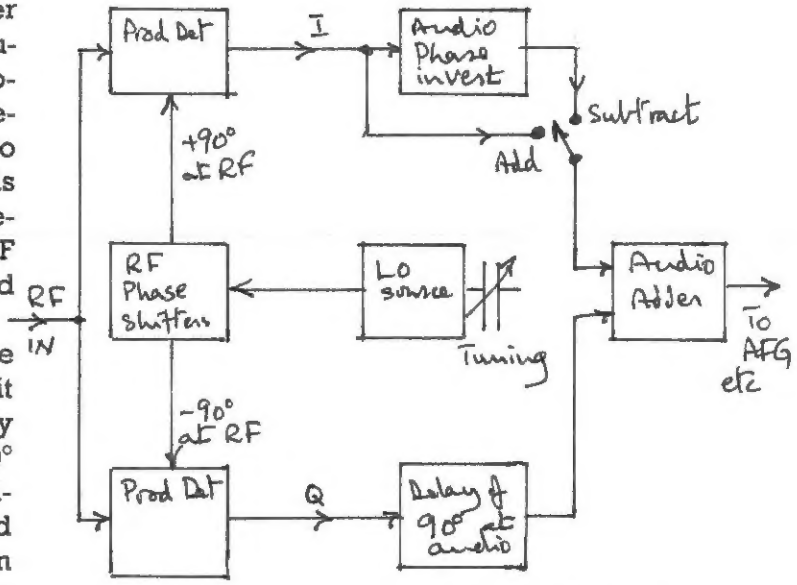
Philip tells me he has just added the Mini AGC kit to his Berrow; and says 'It completely transforms the listening experience with phones - no more head thumping large signals - fantastic!'

The Cadbury Phasing kit

Early trials of the South Cadbury TX (CW) showed it to be struggling on 20m! This turned out to be the usual problem of the high gate capacitance of the IRF510 in the 5W output stage FET. With a little encouragement from Peter Thornton, this was easily solved with a bipolar complimentary emitter follower stage to provide the necessary low impedance drive. The rig is now working well on all four bands 20 - 80m.

The North Cadbury RX is direct conversion and therefore allows use on either sideband of the wanted station. Unfortunately, the unwanted strong one on the opposite sideband is also present! One way of removing him, and boosting the wanted, is to use the *phasing* detection technique. This is especially suitable for direct conversion receivers because it avoids complicated RF filters/mixers and maintains that clean sound for which DC RXs are renown.

The block diagram right shows the principle, the incoming low level RF is split into two channels which feed two ordinary product detectors whose LO signals are 90° out of phase. After (the normal) audio amplification, one of the audio signals is delayed by a further 90° so that the resulting audio in the two channels is 180° out of phase. By then adding or subtracting the two audio signals, the output is either enhanced or removed!

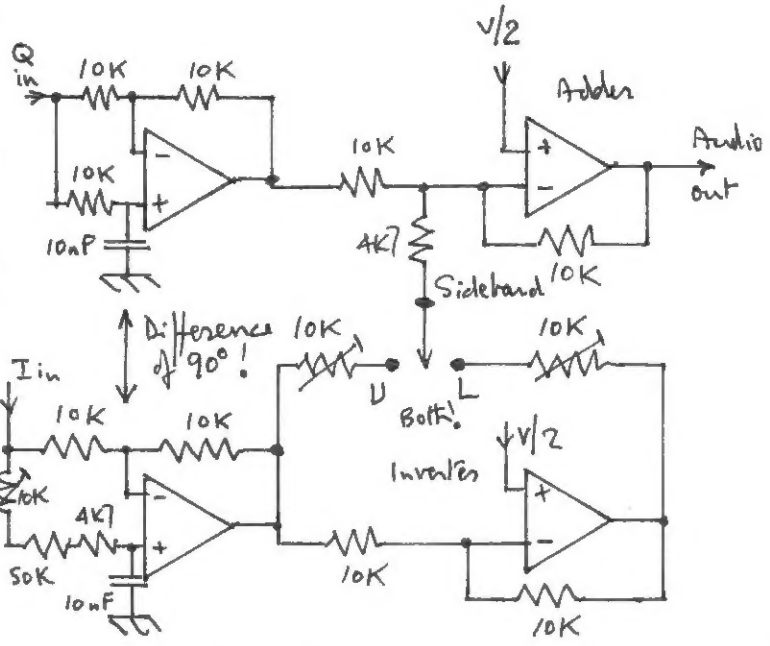


Phasing RX - simplified block diagram

© G3PCJ

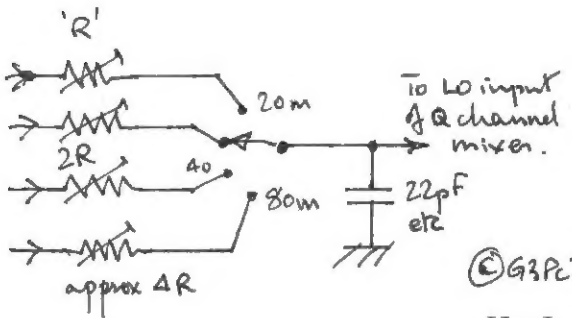
In reality life is always a bit more complicated but is still rather easier than making a multiband superhet like the Minster!! The North Cadbury RX has 74HC4066 switches for the product detector - only two are required for each channel so the second pair can feed the extra audio channel and phase shifting circuits. Its unwise to do the phase shifting and nulling/addition at very low level so some of the RX audio amplification and filtering is duplicated in the second channel. If the audio phase shifter were perfect it would delay one channel by 90° over the whole audio bandwidth from 300 to 3000 Hz - this is rather challenging! So bearing in mind this is primarily a CW RX, maintaining the 90° difference over say 500 to 1000 Hz will be adequate. This is most easily done with two *All-pass* filters which have unity gain but delay the signal depending on the C and R values at the op-amp positive input. The circuit is sown right.

The final item is the RF phase shifting - because the product detectors are digitally driven from the Four BLO, a simple CR for each band (below) looks possible! I will try it shortly! G3PCJ



Audio Phase shifting - all op-amps 072 etc

© G3PCJ

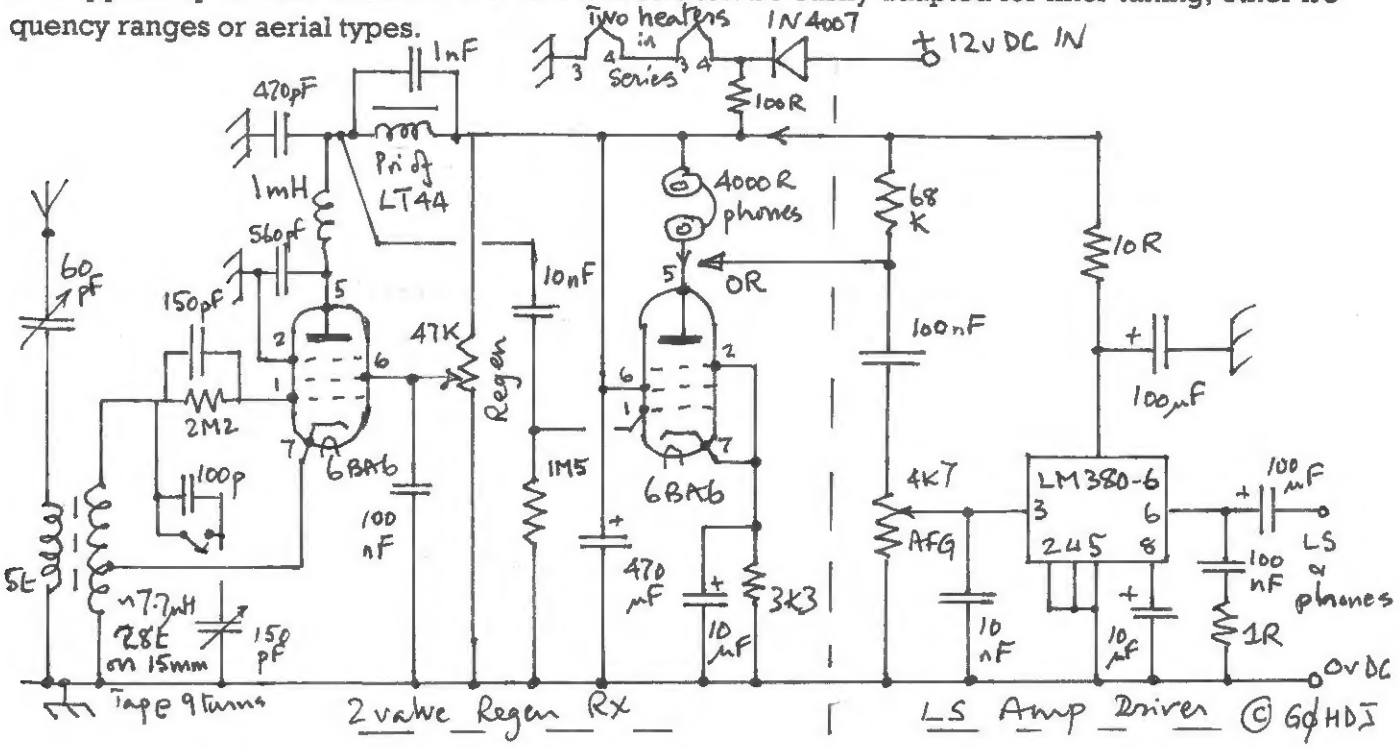


©G3PCJ

LO Delay circuit to provide one quarter of period!

Valved hybrid Regen RX - by Craig Douglas G0HDJ

Craig responded to my comments in an earlier Hot Iron and sent along this design which he has built successfully. Unusually, the supply is 12 volts both for the two series connected heaters of the 6BA6s but also for the High Tension (HT)! My valve consultant tells me that the recommended 6BA6 is an RF pentode that should not be much good with such a low HT but Craig says it works well! The circuit is an adaptation of one by W3IRZ which only had the two valves feeding a pair of 4000R phones. Not having such rare items, Craig has added a semiconductor LM380 LS driver stage also running off the 12v supply. The valve part of this circuit should work quite happily with HT supplies up to 150v or more! The tuned circuit can be easily adapted for finer tuning, other frequency ranges or aerial types.



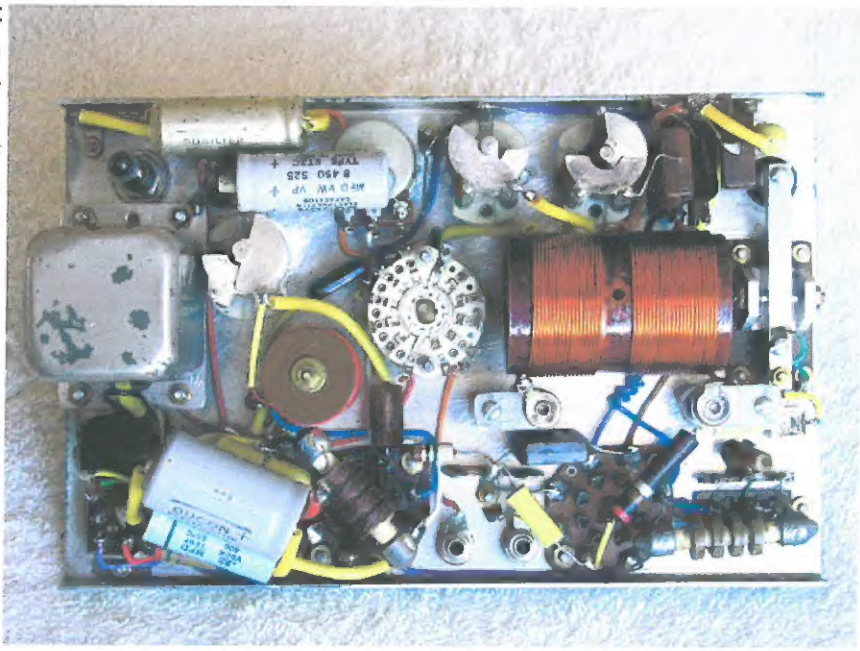
I had thought that I ought to do a valve RX kit but new valves are expensive and have many disadvantages compared to the cheapness, ease of use and performance of semiconductors. My expert on these matters suggests that the best use for glass envelopes is for storing that special amber liquid from Scotland, or for encasing 4CX250's! All other uses should be forgotten! G3PCJ

Test Box Competition!

The prize for this informal competition is a two band transmitter low pass filter kit complete with relay switching for any pair of bands 20 - 80m. I have often thought that for all those people who like going portable, they should really take some simple test equipment with them because this method of operating can be quite demanding. (It is actually what makes military manpack sets so expensive!) Several factors are against you - probably poor battery supplies, small inefficient antennas and a challenging physical environment, where the elements may intrude into the equipment or the temperature change quite suddenly! So tell me what facilities you think ought to go in a portable operations 'test box'. I have seen some American suggestions for a piece of kit that would not be out of place on many home benches let alone up a mountain, but knowing that all you fellows love going out unsupported in the wild, I expect rather simpler items! In the event that I am overwhelmed with suggestions, I will consult an expert on such operations! Write me a brief note for the next Hot Iron complete with circuits as appropriate please. Tim G3PCJ

Replica Paraset

by Rob Firman ZL1CV



Around about 1956, as a teenage lad, I read a book called ' TWO EGGS ON MY PLATE ' by Oluf Reed Olsen and my imagination was fired by the thought of someone Parachuting into Norway and setting up a clandestine radio to transmit information back to the British Military. I was at that time becoming interested in Ham radio eventually gaining my ZL callsign and as a retirement project in 2001 I decided to build a working reproduction of the Paraset as used by Oluf Reed Olsen. There were many versions of the MK7 Paraset and mine is in an oak box with a 230 Volt power supply. From memory I made only two departures from the original circuit. One was to isolate the final tuning capacitor from HT to prevent the chance of shock at the spindle knob and the other was to use a MK1 ZC1 output audio transformer as I was unable to find a suitable period choke. Although a key is fitted to the set I included a socket into which I could plug an external key as was done on some of the original versions. The whole out fit goes into an old leather suit case and it looks the ' Spy Set ' part and yes, I still have to engrave a suitable name and serial number plate.

The little suitcase set goes very well and thanks to the internet we now have access to much information on these past gems. I doubt that I will ever make a G contact on the Paraset but perhaps with a Whaddon MK3, for which I am currently collecting parts to go with my HRO receiver, I may well have a CW contact into the UK.

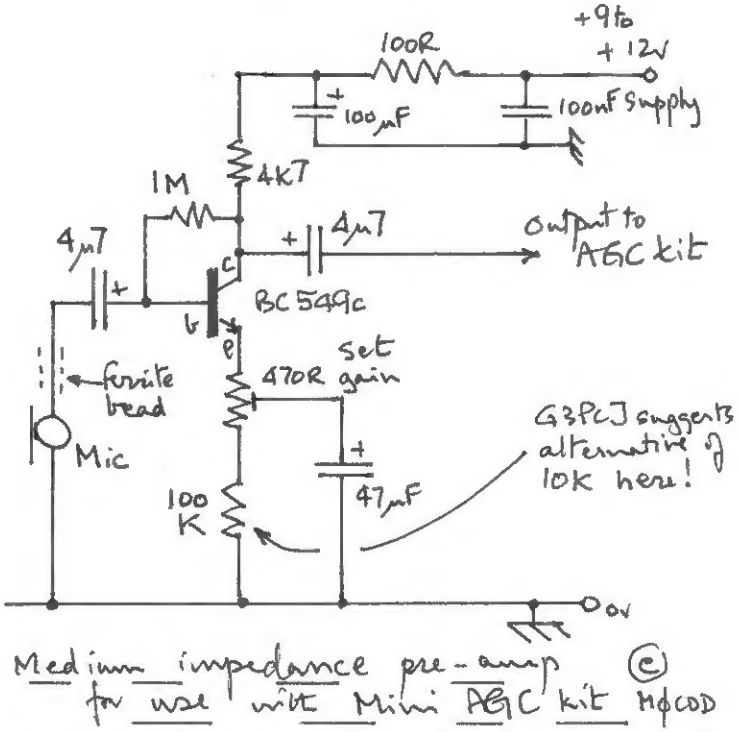
I hope the photos will be of interest to fellow clandestine radio enthusiasts and thanks to Tim for letting me share them.

(This project looks so good I felt it deserves slightly larger pictures than normal! Tim

Audio AGC for microphones by Chas Wilson M0CDD

Normally in my shack I use a desk mic which is amplified by a single stage pre-amp, powered by its own battery. This works well enough but as I have a tendency to go 'off mic', so I have been looking for a some sort of audio Audio Gain Control (AGC) circuit for my mic. A design from an electronics magazine had been tried and rejected, not least of all because it had three pots to adjust - I never managed to get pots in the right place to suit all my rigs!

I was intrigued by the spec of Tim's Mini AGC kit and thought it was worth trying to adapt it. The kit was purchased, constructed and on the bench with the mic feeding into it and monitoring the output on a scope, I realised its potential. A small amount of extra mic gain was needed from the low output desk mic; the existing pre-amp was duplicated dead-bug style and fed into the AGC kit input. This originally gave too much gain so the preset and series resistor were added to control the gain. Now by adjusting the preset I can set it so the audio falls off when I am over about 24 inches from the mic, which allows plenty of room for movement, reaching coffee cups and log books etc. The output of the Mini AGC kit is fed direct into various rigs mic inputs without modification; power lines are well decoupled and ideally the pre-amp/AGC kit might be installed in their own metal box with internal battery! Too much gain will make the audio sound like a speech clipper but will not over-modulate. Users of high output fist microphones might find that a 4K7 preset would be better so the gain can be further reduced if necessary. One could also try feeding the audio from the AGC kit (with or without pre-amp as necessary) into a speech processor so as to raise the average speech level closer to the peak level and thus increase 'talk power'!



The Importance of ESR in choosing electrolytics

A recent note in Electronics Weekly points out that Equivalent Series Resistance (ESR) of electrolytic capacitors is often overlooked. ESR is particularly important in applications with low duty-cycle high peak currents. Power supplies are good example; this applies whether the PSUs are linear or switch mode because there are often high peak currents at the input - in the reservoir capacitor as it is charged up on small duration supply voltage peaks; and also in the output filter capacitors from a load that changes more quickly than the regulator can respond to. 'Wet' aluminium electrolytics have an ESR that is significantly affected by temperature - typically reducing from 1R at –60 °C to about 0.03R at +100 °C. They also dry out with use due to heating with high peak currents, and with age - both of which reduce capacitance and increases ESR. So called 'solid' aluminium electrolytics and hybrid capacitors have a much more stable characteristic that hardly changes with temperature giving an ESR of the order of 0.04R over the usual temp range. In tantalum capacitors, the construction is different with a higher contribution to ESR coming from the end leads.

My own experience is that the extra expense of tantalum caps is only justified where low leakage current is important, eg. in decoupling a varactor tuning voltage against bad supply transients. Normal aluminium electrolytics are fine for most amateur applications but continuous use near their rated voltage is not wise! Better to use a higher voltage one if possible! They also have a very wide tolerance, so if value is critical, double the value! I have also noticed that the more modern ones definitely do not like reversed supply voltage without a current limited supply - quite exciting and messy - but not recommended! G3PCJ

Snippets!

Biodegradable electronics! A team led by John Roberts of the University of Illinois, is developing 'circuits' so thin that they dissolve on contact with just a few drops of water! Comment - it would not be any good in this part of the world or this house - far too damp!

David Buddery G3OEP

I am sorry to report that Dave has died recently after a spell in hospital. Dave did a tremendous amount helping others get into amateur radio and had very wide experience of amateur radio design and operation during his long life. Dave told me that he took part in the very first RSGB field day back in 1937. They used then to have an A and B station, the former on 40 and 80m with the latter on 10 and 20m; they shivered in tents with battery supplies and mostly home brewed gear. Input power was limited to 10W and, for wealthy clubs, the Eddystone All World 2 was a popular RX. This used 2v heater valves in a regenerative detector and audio amp arrangements feeding high Z phones (see G0HDJs design in this Hot Iron). Dave was a good customer of mine, who started with one of my earliest regenerative receivers called the Pitney - a long time ago! He was a regular writer to me on all sorts of radio related matters - often about his knowledge of wartime radio characters. It was he who started me off investigating an interesting man called Bayntum Hippesly who lived originally not far from here in Somerset, who was an early radio enthusiast, and who started off the Royal Navy's Radio intercept activities in Norfolk that were so important in the run up to the Battle of Jutland. This led me literally into a hunt round Hunstanton looking for the sites - the whole topic was most interesting and even helped fill a few pages in Hot Iron! This topic directly led to my subsequent interest in a wartime bunker built for the Auxiliary Units SDS, and its unusual TRD radio, down in Devon. Dave B Snr will be much missed but I pleased to say that his son - another Dave - has the same interests and has also contributed often to Hot Iron! Tim G3PCJ

Pat Hawker G3VA

I am also very sorry to have just heard that Pat died this week. He will be most remembered for his excellent long running **Technical Topics** in Radcom which 'reported' all sorts of old & new ideas.

Amateur Radio in the Country 2013
July 21st.

Make sure the date is in your diary! The night before party is nearby (walking distance), in a friends grain store barn. The theme is a Caribbean Night out complete with a live band, hog roast etc... Those staying nearby overnight have to come as it will certainly be good fun! We should be able to accommodate a few campers in the field close to the barns where the event will be held. Please encourage your local Clubs to put on displays etc.. - plenty of space! Let me know your plans please.

I am pleased to announce the theme for the informal **Construction Challenge** that is to be 'judged' by Graham Firth G3MFJ of the GQRP Club. The task is to build and demonstrate to Graham a CW sidetone oscillator for a TCVR. This might also act as a keyed audio generator for morse practising. It has to feed modern series connected 32R phones presenting a load of 64R. The output should be free of thumps when the key is operated! Nominal frequency to be about 800 Hz and is to run off a 12 volt supply. It is to be keyed either by ordinary contact closure, OR by sensing the RF from a 1.5W transmitter. This latter aspect is to make it both more representative and a bit more interesting as a technical challenge! Construction style is not important as long as it works! Graham's decision will be final! (Meanwhile Ivan G3KLT enjoys a beer and the Plank at QRPiC2012!) Tim G3PCJ